COMMERCIAL RECIRCULATING SEAWATER SYSTEMS FOR HOLDING ROCK LOBSTERS IN TASMANIA, AUSTRALIA

Annual production of southern rock lobsters *(Jasus novaehollandiae)* in Tasmania is usually about 1750 - 2250 t with a landed value of $29.2 million in 1987/88. While the majority are sold chilled or frozen, a proportion are held in land-based tanks prior to domestic or export sale at a premium price as live product. In this paper technical aspects which could have influenced mortality in these systems are discussed. Lobsters may be stressed, prior to reaching the holding facility, by being kept out of water for up to five hours in inadequately cooled vans during road transport. Severe swelling occurs around joints and many rock lobsters have to be processed instead. Loss of limbs also reduces product value.

Ideally, a land-based facility should have a continuous seawater supply with a salinity of more than 27‰ and flow-through holding tanks as large amounts of organic matter are released soon after stocking. Accumulation of organic matter in biofilters leads to excessive oxygen demand and ammonia production by heterotrophic bacteria and sulphide production in any poorly exchanged areas (Forteath, 1990). Recirculating systems are used at most facilities and successful inland units rely almost totally on these systems. They are akin to soft crab or freshwater crayfish shedding systems in that the animals are not fed (Malone and Burden, 1988; Manthe *et al.*, 1988) and water should flow through the holding tank, physical filter, biofilter and cooling system in that order. The holding tank is usually a simple fibreglass or concrete tank of 1 m depth. Rapid sand filtration is preferred over dacron filter media although overloading of sand media with organic matter can occur despite backflushing. A separate biofilter tank, containing shell grit for buffering capacity, is preferred to reduce accumulation of organic matter within the biofilter.

Three key environmental variables influencing biofiltration efficiency are: large salinity fluctuation, water temperature and dissolved oxygen levels. Technical problems including inappropriately insulated buildings and inadequate cooling systems have hindered temperature control in Tasmanian systems. Operators usually aim to operate the systems at 10–12°C thereby reducing ammonia production. Ideally the reduction to 6°C, prior to loading of rock lobsters into export packs, should be done in separate systems as the temperature reduction could disrupt biofilter function. The capacity for maintaining dissolved oxygen levels at 2 mgL^{-1} throughout the biofilter, along with flow rate, surface area of medium and bacterial populations, will determine the amount of ammonia that can be converted to nitrate and hence the biological load that the biofilter can accommodate (Manthe *et al.*, 1988). Biofilters which contain partially exposed media and are supplied with seawater via gentle surface sprays may be adopted. Alternatively, if the biofilter medium is fully submerged, airlift pumps should be included to enhance oxygenation of the biofilter (Manthe *et al.*, 1988). The holding tanks are usually aerated with very turbulent surface generate removable organic foam, and may be augmented with occasional inputs of oxygen especially after stocking of rock lobsters as oxygen demand is high. Although separate aeration systems are rarely included in the designs for holding tanks, they should be used as they enhance circulation near the tank bottom and help ensure that water is well oxygenated before entering the biofilter.

Operators may maintain a small population of rock lobsters or fish in the holding systems to help establish or maintain appropriate bacterial populations e.g. *Nitrosomonas* and *Nitrobacter*, prior to bringing rock lobster densities up to commercial levels in the holding tanks (about 60 kg m^{-3}). Alternatively, commercially available bacteria may be added. However, the biological load should be increased progressively, i.e. no more than 10% per day (Malone and Burden, 1988). Even when high bacterial densities have become established (up to six weeks after initiation of biofilter), sudden increases in loading will exceed the capacity of the biofilter thereby leading to stressful levels of ammonia and nitrite. Unfortunately, as large numbers of rock lobsters become available, the holding systems are subject to sudden changes in loading and often pH, ammonia and nitrite levels are not adequately monitored. However, operators are reducing losses by minimising holding periods for rock lobsters within their systems. At a research level, more information is needed on biofilter design, appropriate biological loads, maintenance of bacterial populations and toxicity of ammonia and nitrite. The use of chemical sources of ammonia and nitrite for conditioning biofilters appears promising (Manthe and Malone, 1987). We were able to condition a tropical marine biofilter in 18 days without a biological load by using commercial bacteria and chemical sources of ammonia and nitrite (NH_4Cl and $NaNO_2$).

Literature Cited

Forteath, G.N.R. 1990. 'A handbook on recirculating systems for aquatic organisms'. (Fishing Industry Training Board of Tasmania: Hobart). 72p.

Malone, R.F. and Burden, D.G. 1988. 'Design of recirculating soft crawfish shedding systems'. (Louisiana State University: Baton Rouge). 74p.

Manthe, D.P. and Malone, R.F., 1987. Chemical addition for accelerated biological filter acclimation in closed blue crab shedding system. Aquacultural Engineering 6: 227-236.

Manthe, D.P., Malone, R.F. and Kumar, S. 1988. Submerged rock filter evaluation using an oxygen consumption criterion for closed recirculating systems. Aquacultural Engineering 7: 97-111.

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